

# **FAR/JAR for the Subpart H**

## **WS-27-03**

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## Subpart H – Electrical Wiring Interconnection System

### § 25.1701 Electrical Wiring Interconnection System

For the purposes of this part, an Electrical Wiring Interconnection System (EWIS) is defined as an electrical connection between two or more points including the associated termination (e.g., connectors, terminal block, splice, etc) devices and the necessary means for its installation and identification. This includes:

Wires (e.g., wire, cable, coax, databus, feeders, ribbon cable, etc.)

Electrical splices  
Materials used to provide additional protection for wires (e.g., sleeving, tapes, etc.)

Bus bars

Shield or braids

Connection to electrical devices (e.g., relays, interrupters, switches, contactors, terminal blocks, feed-through connectors, etc.)

Conduits that have electrical termination (bonding)

Circuit Breakers or other circuit protection devices (not performance)

Clamps and other devices used to route and support the wire bundle

Electrical contacts

Cable tie devices

Connector and accessories (e.g., backshell, sealing boot, grommet, sealing plugs,)

Labels or other means of identification

Electrical grounding and bonding devices (e.g., modules, straps, studs, etc.)

Pressure seals associated with wiring systems

Wiring inside shelves, panels, racks, junction boxes, distribution panels, back-planes of equipment racks (including circuit board back-planes), wire integration units, etc. answering to the upper definition, is included.

The mating connection at the termination point of the wire on those devices that are excluded from this definition is not included as part of the Electrical Wiring Interconnection System

The following is excluded:

- Wiring inside avionics equipment (e.g., flight management system computer, flight data recorder, VHF radio, primary flight display, etc.),
- Equipment qualified to the standards of RTCA Document DO-160, ED14, or shown to be equivalent (other than those specifically included in this definition),

- Equipment qualified to a technical standard order (TSO), or JTSO (Joint TSO),
- Portable, carry on, or otherwise non-permanently mounted (not part of the type design) electrical equipment.
- Fiber optics

#### § 25.1702 Function and installation (25H1301)

Each electrical wiring interconnection system component installed in any area of the aircraft must --

- (a) Be of a kind and design appropriate to its intended function;
- (b) The selection of wires must take into account known characteristics in relation to particular installation and application so as to minimize the risk of wire damage including any arc tracking phenomena (Note: From T6.5, WS 17-05, Item 22)
- (c) Be labeled and identified in accordance with the requirements of § 25.1706
- (d) Be installed according to limitations specified for the EWIS components
- (d') Be installed in accordance with separation requirement of § 25.1705
- (e) Function properly when installed; and
- (f) Be designed and installed such that:
  - (1) Mechanical strain is minimized [is this redundant with 25.1705(n)?]
  - (2) Damage by personnel movement in the airplane during all phases of flight, maintenance, and servicing is minimized
  - (3) Damage by items carried onto the aircraft by passengers, cabin crew, and flightcrew is minimized.
- (g) The installation of main power cables (including generator cables) must be designed and installed to allow a reasonable degree of deformation and stretching without failure.
- (h) EWIS components located in areas of possible moisture accumulation shall be adequately protected to minimize any hazardous effect due to moisture.

From 25.1705 Discussion Tuesday afternoon March 191 that are incorporated above:  
EWIS must be installed according to limitations specified for the EWIS components  
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The installation main power cables (including generator cables) must be designed and installed to allow a reasonable degree of deformation and stretching without failure.

EWIS components located in areas of known moisture accumulation shall be adequately protected to minimize any hazardous affect due to moisture.

#### § 25.1703 Electrical Wiring Interconnection System Failures (25H1309)

The effects of failures of the Electrical Wiring Interconnection System upon its respective systems and the airplane must be assessed in accordance with the requirements of § 25.1309.

#### § 25.1704 Power source capacity and distribution (25H1310)

Electrical wiring interconnection systems associated with “essential loads” on a power supply must meet the requirements of § 25.1310

§ 25.1705 System Separation (25H\_EWIS\_Separation)

- (a) All Electrical Wiring Interconnection System (EWIS) installations must be designed and installed so that under normal or failure condition as defined by 25.1309, it will not adversely affect the simultaneous operation of any other systems necessary for continued safe flight, landing and egress.
- (b) All Electrical Wiring Interconnection System (EWIS) installations must be designed and installed such that any electrical interference likely to be present in the airplane must not result in hazardous effects upon the airplane or its systems except under extremely remote conditions.
- (c) The installation of heavy current carrying cables and their associated EWIS components must be designed and installed to ensure adequate physical separation and electrical isolation, so that damage to essential circuits will be minimized under fault conditions. The physical separation must be achieved by separation distance, barrier, or other means shown to be at least equivalent.
- (d) The installation of an EWIS associated with independent airplane power sources shall be designed and installed with adequate physical separation and electrical isolation so that a fault in any one airplane power source EWIS will not adversely affect any other independent power sources. The physical separation must be achieved by separation distance, barrier, or other means shown to be at least equivalent.
- (1) In addition, electrical airplane independent power sources shall not share a common ground terminating location.
  - (2) Airplane system's static grounds shall not have a common ground terminating location with any of the airplane independent power sources.
- (e) Except to the extent necessary to provide electrical connection to the fuel systems components the installation of an EWIS shall be designed and installed with adequate separation distance or barrier from fuel lines and other fuel system components, such that
- (1) Any EWIS component failure will not create a hazardous condition.
  - (2) Any fuel leakage onto EWIS components will not create a hazardous condition.
- (f) Except to the extent necessary to provide electrical connection to the hydraulic systems components the installation of an EWIS shall be designed and installed with adequate separation distance or barrier from hydraulic lines and other hydraulic system components, such that
- (1) Any EWIS component failure will not create a hazardous condition.
  - (2) Any hydraulic fluid leakage onto EWIS components will not create a hazardous condition.
- (g) Except to the extent necessary to provide electrical connection to the oxygen systems components the installation of an EWIS shall be designed and installed with adequate separation distance or barrier from oxygen lines and other oxygen system components, such that any EWIS component failure will not create a hazardous condition.

(h) Except to the extent necessary to provide electrical connection to the water/waste systems components the installation of an EWIS shall be designed and installed with adequate separation distance or barrier from water/waste lines and other water/waste system components, such that

- (1) Any EWIS component failure will not create a hazardous condition.
- (2) Any water/waste leakage onto EWIS components will not create a hazardous condition.

(i) The installation of EWIS must be designed and installed with adequate separation distance or barrier between the EWIS and flight or other mechanical control systems cables, and associated system components such that,

- (1) Chafing, jamming, or other interference are minimized and
- (2) Any EWIS component failure will not create a hazardous condition and.
- (3) Failure of any flight or other mechanical control systems cables or systems components will not damage EWIS and create hazardous condition.

(j) The installation of EWIS must be designed and installed with adequate separation distance or barrier between the EWIS components and heated equipment, hot air ducts, and lines such that

- (1) Any EWIS component failure will not create a hazardous condition.
- (2) Any hot air leakage or generated heat onto EWIS components will not create a hazardous condition.

(k) Where FAR/JAR 25 specific system requirements are achieved by redundancy, installation of EWIS components must be designed and installed with adequate separation distance or barrier.

(l) The installation of EWIS shall be designed and installed such that it is adequately separated from the aircraft structure, protected from sharp edges and corners, and to minimize potential for abrasion/chafing and vibration damage.

#### **§ 25.1706 EWIS Component Identification** (25H\_EWIS\_Identification)

(a) EWIS components must be labeled as to its identification, function, or operating limitations, or any applicable combination of these factors.

(b) In addition to the requirement of (a) above, when assessed in accordance with **§ 25.1705** as required for the safe flight, landing, egress, or having the potential to impact the ability of the flight crew to cope with adverse operating conditions, concerned EWIS parts shall be particularly identified to its component part number, function and separation for bundles

- (1) The identification must be placed along the wire or wire bundles at appropriate intervals and in areas of the airplane so they are readily visible to maintenance, repair, or alteration personnel so they do not violate the associated or adjacent system design and separation requirements.
- (2) As all components cannot physically be marked, other means of identification should be provided.

- (c) The identifying markings required by paragraphs (a) and (b) must remain legible throughout the design life of the EWIS component.
- (d) The means used for identifying EWIS components required by this chapter shall not have an adverse affect on the components performance throughout the design life of the EWIS component.
- (e) EWIS modifications to the original type design shall be designed, installed and identified to the same standards, or equivalent standards used by the original aircraft manufacturer.

#### § 25.1707 Fire protection: Electrical Wiring Interconnection Systems (25H869)

- (a) EWIS components must meet the applicable fire and smoke protection requirements of 25.831(c). and 25.1718. EWIS components must be constructed and installed so that in the event of failure, no hazardous quantities of toxic, smoke, or noxious products will be distributed in the crew and passenger compartment.
- (b) EWIS components located in designated fire zones, that are necessary during emergency procedures, must be at least fire resistant.
- (c) Insulation on electrical wire and electrical cable, including materials used to provide additional protection for the wire and cable installed in any area of the airplane must be self-extinguishing when tested in accordance with the applicable portions of part I, appendix F of this part.

#### § 25.1708 System lightning protection (25H1316)

For the effects of a lightning strike on Electrical Wiring Interconnection System associated with systems whose failure could effect the continued safe flight and landing of the airplane compliance with the requirements of § 25.1316 must be shown.

#### § 25.1709 Electrical bonding and protection against lightning and static electricity (25H899)

Electrical wiring interconnection system components used for electrical bonding and protection against lightning and static electricity must meet the requirements of § 25.899

#### § 25.1710 Circuit protective devices (25H1357)

- (a) If thermal circuit breakers or fuses are used for the protection of EWIS components the following requirements apply, otherwise the requirements of § 25.1357 apply:
  - (1) Automatic protective devices must be used to minimize distress to the electrical system and hazard to the airplane in the event of Electrical Wiring Interconnection System faults or serious malfunction of the system or connected equipment.
  - (2) EWIS components.....The protective and control devices in the generating system must be designed to de-energize and disconnect faulty power sources and power transmission equipment from their associated busses with sufficient rapidity to provide protection from hazardous over-voltage and other malfunctioning. (iii) Each

resettable circuit protective device must be designed so that, when an overload or circuit fault exists, it will open the circuit irrespective of the position of the operating control.

(3) If the ability to reset a circuit breaker or replace a fuse is essential to safety in flight, that circuit breaker or fuse must be located and identified so that it can be readily reset or replaced in flight. Where fuses are used, there must be spare fuses for use in flight equal to at least 50 percent of the number of fuses of each rating required for complete circuit protection.

(4) Each circuit for essential loads must have individual circuit protection. However, individual protection for each circuit in an essential load system (such as each position light circuit in a system) is not required.

(b) For airplane systems that require the ability to remove power during normal operation, circuit breakers shall not be used as the primary means to remove power from the system.

#### § 25.1711 General (25H.1351)

Components of Electrical Wiring Interconnection Systems must meet the applicable requirements of § 25.1351

#### § 25.1712 Electrical equipment and installations (25H.1353)

(a) Electrical cables and cable installations must be designed and installed so they are compatible with the circuit protection devices required by § 25.1710 such that a fire or smoke hazard cannot be created under temporary or continuous fault conditions.

(b) Electrical bonding provided by EWIS components must provide an adequate electrical return path under both normal and fault conditions, on airplanes having grounded electrical systems.

#### § 25.1713 Distribution system (25H.1355)

Electrical Wiring Interconnection System components associated with the electrical distribution system must meet the requirements of § 25.1355.

#### § 25.1714 Instruments using a power supply (25H.1331)

EWIS components associated with instruments required by 25.1303(b) that use a power supply must be designed and installed such that compliance with 25.1331(a)(2) is ensured.

#### § 25.1715 Accessibility Provisions (25H.611)

(a) Where possible means must be provided to allow:

- (1) inspection of electrical wiring interconnection systems
- (2) replacement of EWIS components as necessary for continued airworthiness.

#### § 25.1716 Pilot Compartment View (25h773)



EWIS components of the window de-ice system must meet the requirements of 25.773(b)(2).

**§ 25.1717 Cargo or baggage compartments** (25H855)

EWIS shall not be installed in cargo or baggage compartments unless:

- (1) They cannot be damaged by the movement of cargo **and personnel** in the compartment, and
- (2) Their breakage or failure will not create a fire hazard.

**§ 25.1718 Flammable fluid fire protection** (25H863)

Electrical Wiring Interconnection System components must be considered to be a potential ignition source in each area where flammable fluid or vapors might escape by leakage of a fluid system and must meet the requirements of § 25.863.

**§ 25.1719 Engines** (25H903)

(a) Electrical wiring interconnection systems associated with **any powerplant** must be designed and installed so that the failure of an EWIS components will not prevent the continued safe operation of the remaining engines; or require immediate action by any crew member for continued safe operation in accordance with the requirements of 25.903(b).

(b) **Design precautions must be taken to minimize the hazards to the aircraft due to EWIS damage in the event of an** engine rotor failure or of a fire originating within the engine which burns through the engine case in accordance with the requirements of 25.903(d)(1).

**§ 25.1720 Engine ignition systems** (25H1165)

Electrical Wiring Interconnection System components associated with engine ignition systems must meet the applicable requirements of § 25.1165

NOTE: Paragraph 25.1165(d) is not part of JAR 25.

**§ 25.1721 Shutoff means** (25H1189)

Electrical Wiring Interconnection System associated with each flammable fluid shutoff means and control must be fireproof or must be located and protected so that any fire in a fire zone will not affect operation of the flammable fluid shutoff means in accordance with the requirements of § 25.1189

**§ 25HXXX Fire detector systems – general**

**For any installed fire protection systems the EWIS associated with that system must meet the applicable requirements for that particular system, and must be shown to be effective for all operating configurations and conditions.**



§ 25.1722 Powerplant and APU Fire detector system – electrical wiring interconnection systems (25H1203)

- (a) Electrical Wiring Interconnection Systems that are part of each fire or overheat detector system in a fire zone must be at least fire-resistant.
- (b) No EWIS component of any fire or overheat detector system for any fire zone may pass through another fire zone, unless --
- (1) It is protected against the possibility of false warnings resulting from fires in zones through which it passes; or
  - (2) Each zone involved is simultaneously protected by the same detector and extinguishing system.
- (c) Compliance with the requirements of § 25.1207 must be shown.

§ 25.1723 Electrical Shock and Burn (25H1360)

Electrical Wiring Interconnection System components must be designed to minimize the risk of electric shock and burns in accordance with the requirements of § 25.1360(a).

§ 25.1724 Electrical Supplies for Emergency Conditions (25H1362)

EWIS components for the electrical services required for emergency conditions must meet the requirements of 25.1362.

§ 25.1725 Electrical Appliances, Motors, and Transformers (25H1365)

Electrical Wiring Interconnection System components associated with electrical appliances, motors and transformers must meet the requirements of § 25.1365

§ 25.1726 Electronic equipment (25H1431)

Electrical Wiring Interconnection System components associated with radio and electronic equipment and controls must meet the requirements of § 25.1431 (c) and (d).

§ 25H1529

The following must be addressed in the instructions for continuing airworthiness required by 25.1529:

Some ideas for discussion:

- NOTE: Identification and documentation issue – documents, drawings, etc that need to be supplied to operators etc. (e.g., engine wiring information)
- What has Task Group 9 recommended with respect to changes/additions to 25.1529?
- Verify separation distances are maintained????
- Bonding verification
- Task Group 9 recommends that the following be added as new 25.1309(h): each mandatory certification and maintenance requirement developed to show compliance with paragraph (b) of this part must be included in the airworthiness limitations section of the ICAW required by 25.1529.

- Appendix H: h25.4 Each mandatory CMR approved under 25.1309/1703 for equipment systems and installations
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